ME 20N: Haptics: Engineering Touch

Syllabus ◆ Autumn Quarter 2017

Description

Students in this class will learn how to build, program, and control haptic devices, which are mechatronic devices that allow users to feel virtual or remote environments. In the process, students will gain an appreciation for the capabilities and limitations of human touch, develop an intuitive connection between equations that describe physical interactions and how they feel, and gain practical interdisciplinary engineering skills related to robotics, mechanical engineering, electrical engineering, bioengineering, and computer science. In-class laboratories will give students hands-on experience in assembling mechanical systems, making circuits, programming Arduino microcontrollers, testing their haptic creations, and using Stanford's student prototyping facilities. The final project for this class will involve creating a novel haptic device that could be used to enhance human interaction with computers, mobile devices, or remote-controlled robots. *Pre-requisites: high-school physics (non-calculus), pre-calculus, and at least a little familiarity programming. Building and mechatronics experience are not required!*

Instructor

Prof. Allison Okamura, Bldg. 550 Room 107, aokamura@stanford.edu, office hours to be scheduled
Allison's administrative assistant is AJ Fabry, Bldg. 550 Room 114, ajfabry@stanford.edu
Course Development Assistants: Kaitlyn Gee (kegee@stanford.edu) and Tyler Cloyd (tcloyd@stanford.edu)
Hapkit and Haplink developer: Melisa Orta (melisao@stanford.edu)

Course Time/Location

Lectures and Labs: Building 524, Room 145 (also known as the d'Arbeloff Teaching Lab)
Meeting time: Tuesdays and Thursdays, 1:30-2:50 pm
Course website: http://me20n.stanford.edu
There is no textbook for this class
Bring your laptop and its power cord to class, or let Allison know if you don't have one

Course Objectives

By the end of ME 20N, you should be able to:
1. Identify the primary mechanisms of human haptic sensing, as well as the capabilities and limitations of human touch
2. Describe the salient features of a haptic device design and the physics of a haptic mechanism
3. Understand methods for sensing the position of and actuating haptic interfaces
4. Assemble and program a haptic device (http://hapkit.stanford.edu) to create compelling touchable virtual environments
5. Explain current and invent potential future applications of haptic devices
6. Design and build a new haptic device

Administrative Stuff

- Grading: The class is graded on letter grade basis. To earn an A in the course, you must **complete all laboratory assignments on time (50%)**, **complete a successful final project and give a demonstration/presentation (40%)**, and **participate actively in all classes (10%)** or arrange a suitable makeup for up to one session in advance.
- Assignments: Laboratory assignments will be completed in class, and done as homework if not completed in class. Project activities and presentations will also be required in the latter half of the course.
- Absences/Make-ups: Attendance at all sessions and completion of all assignments and project are required to receive full credit for the course. A makeup session may be substituted for any class except the final presentations by prior agreement between you and Allison. (If you know up front you have a conflict, plan ahead and let me know ASAP!)
- Students with documented disabilities: Students with Documented Disabilities: Students who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty dated in the current quarter in which the request is made. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations. The OAE is located at 563 Salvatierra Walk (phone: 723-1066, URL: http://studentaffairs.stanford.edu/oae).

Tentative Schedule

Week	Date	Activity	Assignments
1	Tue 9/26 Thu 9/28	Introduction to haptics and human touch Human touch experiment, Haptic device design	Lab 1: Two-point discrimination PRL safety training
2	Tue 10/3 Thu 10/5	Device kinematics, CAD and 3D printing Product Realization Lab (PRL) Room 36 introduction	Lab 2: Make Hapkit handle PRL shop training
3	Tue 10/10 Thu 10/12	Device forces, 1-D Hapkit assembly Control board, sensors, and actuators	Lab 3: Hapkit assembly
4	Tue 10/17 Thu 10/19	Hapkit system testing Introduction to programming (optional)	Lab 4: Hapkit testing
5	Tue 10/24 Thu 10/26	Programming 1-D virtual environments Programming 1-D virtual environments	Lab 5: 1-D virtual environments
6	Tue 10/31 Thu 11/2	2-D Haplink kinematics 2-D Haplink assembly	Lab 6: Haplink assembly and testing
7	Tue 11/7 Thu 11/9	Programming 2-D virtual environments Programming 2-D virtual environments	Lab 7: 2-D Virtual environments
8	Tue 11/14 Thu 11/16	Project Introduction Work on projects in class	Project proposals
Thanksgiving Recess 11/20-11/24 (No Class)			
9	Tue 11/28 Thu 11/30	Work on projects in class Work on projects in class	Project prototype presentation
10	Tue 12/5 Thu 12/7	Work on projects in class Haptics Open House / Course wrap-up	 Project demonstrations
Project Reports Due Online 12/14 at 5 p.m.			